Comunicazioni orali libere 3

Presentazione Orale

Investigating cross-modal properties of the primary somatosensory cortex by means of a novel cross-modal Paired Associative Stimulation protocol

Agnese Zazio[1], Ottavia Maddaluno[1], Giacomo Guidali[2], Nadia Bolognini[1], Carlo Miniussi[3]
[1]Department of Psychology, University of Milano-Bicocca, Milan, Italy
[2]PhD program in Neuroscience, School of Medicine and Surgery, University of Milano-Bicocca, Monza, Italy
[3]Center for Mind/Brain Sciences (CIMeC), University of Trento, Rovereto, Italy

A growing body of evidence suggests the existence of a Tactile Mirror System in the human brain: the observation of tactile events activates the same cortical network implicated in tactile perception, including the primary somatosensory cortex (S1). It has been suggested that such cross-modal, mirror-like, responses of S1 may arise from Hebbian associative learning: the contingency of seeing a touch and the feeling of a tactile sensation may reinforce synapses between visual and somatosensory neurons. The neurophysiological mechanism underlying the Hebbian associative learning is referred to as Spike-Timing Dependent Plasticity (STDP), in which the relative timing of action potentials between pre-synaptic and post-synaptic neurons determines the strength of neural connections. The Paired Associative Stimulation (PAS) represents an especially suitable protocol to non-invasively investigate the mechanisms of STDP in humans. In classic PAS protocols, a pulse of Transcranial Magnetic Stimulation (TMS) over the cortical area of interest (e.g., S1) is repeatedly paired with a peripheral stimulation (e.g., electrical stimulation of the median nerve).
In the present study, we have developed a novel cross-modal PAS (cmPAS) with the aim of investigating the involvement of STDP mechanisms in the cross-modal properties of S1 in healthy individuals. In the cmPAS, the peripheral stimulation was replaced with a cross-modal stimulus, i.e., a visual stimulus depicting a hand being touched, which was paired with the TMS pulse over S1.
We investigated the efficacy of the cmPAS in a series of three experiments, controlling for factors such as: the inter-stimulus interval (ISI) between the seen touch and the TMS pulse, the cortical site of stimulation and the content of visual stimulus. Plasticity effects induced by the cmPAS were assessed in terms of changes in tactile acuity and, in the last experiment, also by means of a neurophysiological index, i.e. the somatosensory evoked potentials (SEPs).
The cmPAS induced a consistent and significant improvement in tactile acuity only at selective ISI (20 ms), site of stimulation (S1) and visual stimulus (a hand being touched). Furthermore, preliminary results showed a modulation of SEPs by the cmPAS, whose efficacy was compared to a control PAS protocol, corroborating behavioral findings and suggesting that plasticity mechanisms occur at the cortical level, possibly in S1.
Taken together, the present findings showed the efficacy of the cmPAS in driving plasticity, suggesting that Hebbian associative learning within S1 can be effectively induced through vision.